

Remarks

Review of claim objections (37 CFR §1.75(c)) made by the examiner

Claims 14 to 18 were objected to as being in improper form because a multiple dependent claim cannot depend from another multiple dependent claim. I have amended claims 14, 15, 16 and 17 so that they are no longer multiple dependent claims. Since claim 18 was not a multiple dependent claim but only depended on a single claim that was objected to and now amended it should now be in proper form without any modifications.

Review of rejections (35 USC §102) and references made by the examiner

Regarding My Claim #1:

In Relation to U.S. Patent 5,267,097 (Ogino et al.):

Ogino suggests that "information is read out from the track of the disk and stored in a buffer memory without waiting a read command from a host side controller". This solution is based on track-level addressing, whereas in my invention the data is read from multiple surfaces and from multiple angles at the same time, immediately after any of the heads reach their position. This is different in that tracks are not fetched one by one but a whole cylinder is fetched from possibly multiple different angular positions at the same time. None of publicly available hard disk drives implement Ogino's solution, suggesting lack of efficiency, effectiveness, improvement or implementation details in Ogino's proposal.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #2:In Relation to U.S. Patent 5,267,097 (Ogino et al.):

Ogino discusses the general implementation of this feature from the perspective of controller. However, he does not address any mechanical issues at all. Furthermore, he does not provide any explanation on how to handle hard disks with very high track densities. With such hard drives even minute thermal and other deformations may cause the tracks of the same logical cylinder to be misaligned. This issue did not exist at the time of Ogino's patent application as such high track densities were not available, so the problem may have been unrecognized by Ogino or deemed insoluble or unworkable.

No hard disk drives exist or are available publicly with this implementation, meaning that the prior art solution is incomplete, inefficient or otherwise unworkable.

In Relation to U.S. Patent 6,546,499 (Challener et al.)

Challener does discuss the logical implementation of RAID within a single hard disk drive, or as he describes it as RAIP. He also mentions and claims the idea of "micro-adjusters" as one way of compensating for thermal deformations, but does not provide any solution to implementing those whatsoever. Challener merely implements existing RAID technology inside a single device, describing some data organization aspects and requirements for device implementation. Although my invention has similarities with RAID, it provides actual solutions to problems not even mentioned by Challener. Furthermore, my invention goes beyond RAID configurations, exploiting what can be done inside one device, whereas Challener's invention does not – it is restricted to organizing data inside a single hard disk drive in order to mimic RAID operation. Thus, Challener's invention provides less advantages (if any when cost efficiency is examined) over existing RAID systems than systems that can be built using my invention.

Also, my invention is not restricted to having all heads positioned on the same cylinder, as Challener teaches in his invention. My invention does allow for this, but also allows the device to reconfigure itself or to move heads one or more at a time to other cylinders in order to proceed read or write operations at the new location immediately, while other heads will only follow. None of prior art teachings allow for this.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #3:

In Relation to U.S. Patent 5,267,097 (Ogino et al.):

Ogino not only does not teach of data reorganization, but also fails to teach how to implement a device that can read and/or write with plural heads. He does not recognize a number of mechanical problems associated with this idea, therefore not providing the solution to the problem at all, but only the requirements and the controller logic. My claim #3 is a result of solutions presented in my invention, and from perspective of my invention (and not Ogino's) it may appear obvious – but only with hindsight of my invention, not other inventions (as they do not recognize the problem or assume insolubility or unworkability).

Ogino's invention has a different goal which it achieves and is therefore complete in itself in achieving that goal. As mentioned above, scope of Ogino's invention is also different. Having both different scope and different goal, Ogino's and my invention are, in fact, different and may, in some cases be applied together (i.e. they do not necessarily exclude one another).

In Relation to U.S. Patent 6,546,499 (Challener et al.):

Challener not only does not teach of data reorganization this way, but also fails to teach how to implement a device that can read and/or write with plural heads and, at the same time, only discusses the implementation of prior art known as RAID within a single hard disk drive. He does not recognize a number of mechanical problems associated with this idea or required changes to the controller, therefore not providing the solution to the problem at all, but only the requirements for the system that were already known with RAID. Furthermore, Challener's invention does not teach of the possibility to re-order sectors to improve performance with multiple heads reading data from different angular positions on the same cylinder. This is implied and inherent in my claim #3 as it is explicitly described in the description of the invention itself.

Also, my claim #3 is a result of solutions presented in my invention, and from perspective of my invention (and not Ogino's or Challener's) it may appear obvious only with

the hindsight of my invention specification, not other inventions (as they do not recognize the problem or assume insolubility or unworkability).

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #4:

In Relation to U.S. Patent 6,546,499 (Challener et al.)

Challener teaches that one platter must be dedicated for "parity bit" or otherwise having "identical set of data" (mirrored data). This is inherent to any system based on RAID. My invention, however, does not require that a separate platter is dedicated to parity, nor that there is mirrored data. Error correction data of any form can be used (i.e. not only parity) and does not need to be all on dedicated platter. This information, for example, may be all be located on a single surface alone (one side of a platter). Alternatively, my invention also allows for error correction data to be stored even within another sector of the same track (effectively simultaneously read or written by another head that is on the same track) or anywhere else within the cylinder.

Lastly, my claim does not include only "error correction" information but "additional control information" which includes above mentioned error correction, and also allows any additional control information, such as address marks, synchronization information or any other meta-information to be stored at alternative locations different from those established in any prior art.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #5:

In Relation to U.S. Patent 6,546,499 (Challener et al.)

At column 2, line 22 Challener only mentions the prior art (RAID 3) related to both his and my invention. However, Challener teaches that "RAIP 3 stripes data one group of bits or bytes at a time across all the multiple platters 12A, 12B, and 12C (i.e. platters 1, 2, and 3) within the

single disk drive 10B" (column 7, lines 37-39). This simplification of the design causes the inability to make tradeoffs between streaming and random-access performance. In my invention not all platters have to be used for a single data chunk. Rather, my invention allows for surfaces to be divided into striping blocks, if and whenever this is deemed more optimal for the desired device usage. Furthermore, Challenger does not allow angular stripping of data (but only stripping across surfaces) as his invention is limited to implementing RAID operation within a single device.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #6:

In Relation to U.S. Patent 6,546,499 (Challener et al.)

Same comments apply as to my claim #4 in relation to Challenger et al.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #7:

In Relation to U.S. Patent 6,546,499 (Challener et al.)

Not only that Challenger does not teaches of such improvement to the interface, but it is also not obvious as there are, apparently, unrecognized problems that are actually mentioned in the description of my invention. Such interface requires communication protocol changes and requires that device is able to send messages to the host system even regarding data that it did not require (e.g. while reading data ahead of time).

Such system does not exist as of yet. The closest available technology is S.M.A.R.T. but it only provides loosely related general device health information and only on demand. My claim specifically relates to the ability of the interface to synchronously or asynchronously (whichever way, not specified) send notifications to the host system that although the data has (or has not been) required and read correctly, it is only because a serious error was automatically corrected, therefore bringing the problem directly to host's attention.

Without an interface just like that, the device would have an option to, for example, turn on a light (e.g. LED), or wait for the host system to demand the general health information. In neither case the information presented to human system operators is specific and can not be delivered as an urgent notification to the operator. Having in mind that many commercial hard disk drive pools sit in servers located in special and remote server rooms, physical indicators on the device itself would loose any meaning, while neither that or on-demand device health information is specific to the problem. Having specific information on time can allow the host system to even automatically back up or even reorganize affected files (data) such that they are moved away from the affected area, therefore acting immediately on the most critical data. Again, without this, it is a matter of backing up, removing and replacing the whole device, regardless of the actual problem.

Lastly, this is obvious only with the hindsight of my invention. Although my claim is possible to implement even outside of the scope of the rest of my invention, it has not been implemented, suggesting that it is not obvious and/or that there are unrecognized problems, unrecognized advantages and/or assumed unworkability or insolubility.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #8:

In Relation to U.S. Patent 5,343,347 (Gilovich)

Gilovich's invention teaches the use of multiple actuator arms to handle different, non-intersecting, platters, surfaces or parts of surfaces. It is targeted at minimizing the track seek times and increasing capacity by having more platters, all of which it achieves. Gilovich's and my invention, therefore, have entirely different goals. Gilovich does not discuss the use of multiple heads at the same time. Furthermore, it does not provide the solution for thermal deformations, which was either considered an unappreciated advantage (because hard disk drives were often faster than their hosts could handle) and/or non-existing or unrecognized problem (due to low track densities). Although controller could be made more intelligent and made to be able to handle operation with a plurality of heads, such solution would not be nearly

as energy, cost and performance efficient as the one discussed in my invention. Furthermore, no publicly available hard disk drives implement Gilovich's invention, hence identifying that solution proposed by him is inefficient, ineffective, too costly or otherwise unworkable.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding My Claim #19:

In Relation to U.S. Patent 4,858,040 (Hazebrouck)

Hazebrouck's invention teaches how to improve the performance of hard drives by introducing secondary bimorph actuators. Hazebrouck's actuators are designed to save time and energy in bringing any single head to its proper position. A joint control of secondary actuators only allow all the heads to be moved at the time, which does address the issue of energy and time savings, but does not facilitate proper positioning of all heads on the actuator arm at the same time. In my invention this functionality omitted by Hazebrouck is the only one required, as there is a need to compensate for thermal deformations of platters. Applying my claimed invention to Hazebrouck's design is not any more obvious than applying Hazebrouck's design to common prior art.

As bimorph designs are more prone to aging effects than designs shown in my invention it is expected that they would not last as long. There is also an unrecognized problem of tendency of bimorphs to bend, and possibly vibrate in undesirable manner, especially with age. Furthermore, the design shown in my invention provides greater precision and may require simpler controller logic that only needs to handle minute track misalignments (but not to have to identify actual track numbers). Hazebrouck's proposed solution has not been implemented in any publicly available hard disk drive systems, hence identifying that solution proposed by him is either inefficient, ineffective, too costly or otherwise unworkable.

Re: U.S. Patent 5,521,778 (Boutaghou et al)

Similarly to Hazebrouck's invention, Boutaghou's invention teaches how to implement full secondary actuators that are not used specifically for thermal deformation compensation for

each head separately but are intended for a quite different purpose. In relation to my invention, same comments apply as to Hazebrouck's invention, including the lack of implementation.

My invention may be used together with either Hazebrouck's, Boutaghoul's or both in hard disk drives that see benefits of those – they are not mutually exclusive, although a system may benefit from a design that does not simply put two (or three) systems together but, rather, learns from all systems and implements one with a superset of functionality.

Review of rejections (35 USC §103) and references made by the examiner

Regarding My Claims #9, #10, #11, #12 and #13

Re: U.S. Patents 5,343,347 (Gilovich) and 6,546,499 (Challener et al.)

General remarks: Neither of listed patents include any references or mentions as to how they can be combined, of for that matter, how they can themselves be combined with any other related invention. In order for any prior art references themselves to be validly combined for use in a prior art §103 rejection, the references themselves (or some other prior art) must suggest that they be combined, e.g. as was stated in re Sernaker, 217 U.S.P.Q. 1, 6 (C.A.F.C. 1983). Furthermore, implications selective combination are also stated in Uniroyal, Inc. v. Rudkin-Wiley Corp., 5 U.S.P.Q.2d 1434 (C.A.F.C. 1988).

Finally, my invention is not any more obvious in relation to prior art than Gilovich's and Challener's are in light of their, or even current prior art (excluding my invention). Challener simply applied RAID within the system without really providing the solution. In fact, Gilovich in one of his earlier patents actually describes the same thing Challener is describing, but also comments that is probably not possible to solve. Challener does not introduce new designs or new solutions but only a possibility of a solution. My invention is much more than that. It clearly identifies problems, ideas, reasons, performance differences, impacts, data organizations and actual solutions. My invention is, therefore, complete in light of prior art.

Regarding my claim #9: Applying Challener's invention to Gilovich's device is only possible for hard disk drives with low track densities. Furthermore, it would require the controller to handle complex actuator coordination as data can be striped only angularly, therefore increasing effective seek times and, therefore, reducing the effect of Gilovich's invention. This also proves that the solution to this is not as obvious and that one of ordinary skill can not just merge these two inventions into one. Challener's invention is, in fact, quite incompatible with Gilovich' device as it can not position multiple heads over different parts of the same data, at the same time and Challener does not teach any mechanical implementations. The problem solved by my invention was considered impossible to solve or was unrecognized.

Regarding my claim #10: As explained in remarks for my claim #3, my invention may yield different data organizations than those that are obvious from any of the prior art teachings.

Furthermore, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding my claim #11: As explained in remarks for my claims #4 and #6, my claims are different from those achievable by combining Gilovich's and Challener's devices. Even as it was stated in the office action letter, modifications would have to be made to Gilovich's device in order to achieve this functionality. Challener does not teach of how such modifications are to be achieved (but only requires their functionality). He also teaches only of parity and mirrored data, not of "additional control data" as listed in my invention. Furthermore, my invention is not obvious for the same reasons given in remarks for my claims #4 and #6.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding my claim #12: As shown for my claim #9, application of Challener's invention to Gilovich's device does not constitute a solution. Sector stripping as in RAID or claimed by Challener is not implementable in Gilovich's device without making improvements shown in my invention. Furthermore, my invention allows for angular sector stripping, which is not achievable by any other prior art alone or combined.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Regarding my claim #13: Challener discusses the failure of one or more head pairs within the domain already known in RAID. As stated in Mr. Verbrugge's (examiner's) letter, Gilovich's invention does not include any mention of this. My invention allows for more heads to fail and still be able to continue to operate, although at reduced speed. This is because my invention allows for multiple heads to access the very same data on the very same surface, unlike in either Gilovich's or Challener's invention.

Finally, I have amended my claim in order to narrow it down and exclude any commonality with referenced prior art.

Comparative Table of Inventions

	My Invention	Ogino's	Challener's	Gilovich's	Hazebrouck's	Boutaghou's
Efficiently solves thermal and other deformation issues with high track density hard disk drives?	✓					
Separate micro positioning of each and every head?	✓					
Joint micro-positioning of all heads on one arm?						
Actuator arms travel equivalent, evenly angularly distributed paths, better for synchronizing data?	✓					
Piezo-electric head alignment?	✓					
Bimorph-based secondary head actuators?					✓	
Other secondary actuators?						✓
Head fail-over capabilities?	✓					
Provides data organization details?	✓					
Flexible data stripping organization?	✓					
Data stripping across surfaces?	✓		✓			
Angular data stripping?	✓					
Uses multiple heads at the same time?	✓					
Multiple heads on the same surface?	✓			✓		
Multiple heads on the same cylinder?	✓					
Multiple heads can be on separate cylinders?	✓			✓		
Can read data immediately after seek?	✓	✓				
Continued operation with single-head failure?	✓	✓	✓	✓	✓	✓
Continued operation with multi-head failure?	✓					
Continued operation with data loss (with recovery)?	✓	✓	✓	✓	✓	✓

General Remarks

Although some elements of my invention may seem to appear in existing patents (as prior art), it must be understood that my invention, like most inventions, is not a proposal of entirely new device but describes a significant improvement to existing devices. As such it does share many similar, but not exactly the same components with prior art. The improvement is significant because it achieves more than any other prior art separately or combined, and in the field that is already crowded with many inventions and probably near the end of its commercial usefulness as entirely new types of secondary memories are being invented. My invention has a goal of prolonging the life of existing, inexpensive, technology while the ground is prepared for it to be replaced.

It was argued that improvements suggested in my invention are obvious and that they can be achieved by combining various aspects of prior art. However, many inventions appear obvious in hindsight. Furthermore, there are advantages to my invention that were not identified or were unappreciated during the examination, directly suggesting its unobviousness. If deemed necessary and required, I can provide additional explanations and descriptions to my invention's specification and claims, making it clearer and more identifiable.

Even after combining selected parts of five existing patents it was not possible to achieve all capabilities of my invention. Furthermore, most of referenced prior art can be used in combination with my invention, hence suggesting that these are not mutually exclusive but, in fact, different inventions.

Also, none of the publicly available hard disk drives uses any of the solutions provided by those other patents, and especially not a combination of them. This means that, even after years of availability of these solutions they have not been implemented by any of the industry leaders and their skilled experts. Same is true for my invention, but it has not been officially published yet.

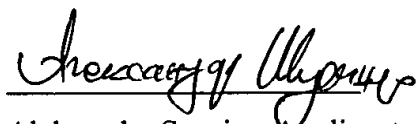
This means that neither the existing solutions is adequate nor that my invention is obvious – none of the prior art even suggests any of the combinations. Otherwise it would have been implemented a long time ago, as it does not require any high-technology manufacturing processes that are not available for a significant time now.

I have been monitoring this since beginning of 1998 when I was doing a research on existing hard disk drives and published a brochure and few magazine articles (finally published in September 1998 in "PC" magazine of "PC PRESS", see <http://www.pcpres.co.yu/arhiva/sadrzaj.asp?broj=38>, none in English, but publicly available for translation) identifying problems of hard disk drives at the time. The publication does not include the solutions to problem (as I started thinking on patenting it) but it does clearly identify the issue.

I myself expected these problems to be solved after publishing the article, but as I realized that solutions to these problems are, in fact, not obvious I decided to revive the idea on patenting the invention once I moved to Canada, in the summer of 1999. This also means that my invention was conceived before Challenger's application was filed, but was sent to US PTO later due to purely technical problems – location, funds and the fact that this patent application is my first and personal application and I had to use my spare family time to study the patent application process and prepare for it.

I have made amendments to the claims of my application and provided additional explanations in above review of rejection in an effort to ensure the correct, proper, definite and unobvious application. If, for whatever reason, this application is not considered to be in full condition for approval, I respectfully request the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. §2173.02 and §707.07(j) in order so that I, as the inexperienced first time applicant, can make this application acceptable as soon as possible and without the need for further proceedings.

Yours very respectfully,



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